TECHNICAL facts

U.S. DEPARTMENT OF ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Global Climate Change

11/2001

CLIMATE CHANGE AND CONVENTIONAL TRANSPORTATION TECHNOLOGIES: AN INEXTRICABLE LINK

The transportation sector is the fastest growing source of greenhouse gas (GHG) emissions worldwide. Motor gasoline consumption yields about one-fifth of all U.S. GHGs alone with one gallon of motor gasoline consumed emitting 19.6 pounds of carbon dioxide and one gallon of diesel emitting 22.4 pounds of carbon dioxide.[1] Mounting evidence indicates that a decrease in carbon dioxide emissions can be achieved by replacing traditional gasoline and diesel-powered vehicles with certain applications of alternative fuel vehicles (AFVs), with natural gas vehicles (NGVs) proving to be a viable short-term to medium-term alternative.[2] The U.S. Department of Energy's (DOE) National Energy Technology Laboratory (NETL) is preparing a study, "Reducing Greenhouse Gas Emissions from Natural Gas Vehicle Projects: A Primer," to provide project developers, national climate change entities, and other public and private sector representatives worldwide with a guide on how to estimate and document the greenhouse gas (GHG) emission reduction benefits and/or penalties of natural gas vehicle (NGV) projects. The study is being prepared as a follow-up to the NETL/Gas Research Institute-sponsored training session, "Developing International GHG Emission Reduction Projects Using Clean Cities Technologies," held May 10, 2000 in San Diego, California and will include recommendations for increasing the number of transportation-related GHG emission reduction projects worldwide.

The Status of International GHG Emission Reduction Projects Using Natural Gas Vehicles

Though the GHG benefits of certain applications of NGVs are proven, there is currently little international experience with GHG emission reduction projects using transportation technologies (Figure 1).[3] Of the 125 Activities Implemented Jointly (AIJ) projects reported to the UNFCCC, there are 108 energy projects, 16 forestry projects, and only one transportation project. There are currently no projects in anticipation of the Clean Development Mechanism (CDM) using transportation technologies specifically for the purpose of reducing GHGs. As of 1998 there were 70 transportation GHG emission reduction projects listed with the U.S. Department of Energy's 1605b Voluntary Reporting of GHGs Program, a small number compared to the 424 electricity generation, transmission, and distribution projects reported that same year.

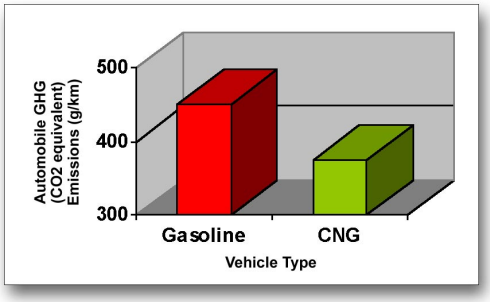

Figure 1. GHG Benefits of Natural Gas Vehicles

Source: Wang, Michael, "Fuel-Cycle Analysis of Transportation Fuels: Development and Use of the GREET Model," Presentation for the NETL sponsored training session, "Developing International Greenhouse Gas Emission Reduction Projects Using Clean Cities Technologies," in San Diego, CA, May 10, 2000.

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The Future of Alternative Fuel Vehicles

The commercial deployment of NGVs continues to increase worldwide as issues including availability of re-fueling infrastructure, reduction of re-fueling time, vehicle range, cost, and performance are resolved. As NGV use grows, major automobile manufacturers and governments are also researching new types of AFVs and ways to improve existing technology. Other advanced technologies with the potential for use in GHG emission reduction projects include electric vehicles that can be recharged more quickly with a longer range, hydrogen fuel cell technology, hybrid electric vehicle technologies, and improve-ments in LNG technologies for bus applications. For model years 1999 and 2000, all of the major automobile manufacturers in the U.S. have offered some type of AFV and have plans to continue to make AFVs available in the future.

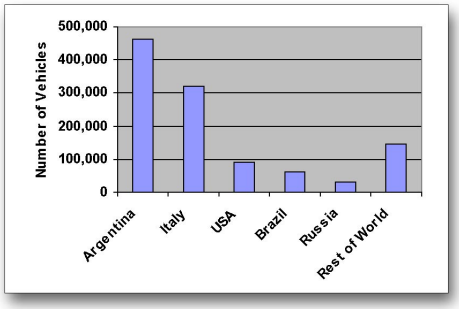

Figure 2. Number of International NGVs

Source: International Association for Natural Gas Vehicles, "International Natural Gas Vehicle Statistics 2000 Online," www.iangv.org/html/ngv/stats.html.

Climate Change and Conventional Transportation Technologies: An Inextricable Link

Availability and Types of Natural Gas Vehicles

As of August 2000, there were approximately 1.1 million NGVs being operated throughout the world. (Figure 2). The majority of these vehicles are converted vehicles, though the number of vehicles being offered by original equipment manufacturers (OEMs) is increasing.

There are two types of NGVs currently available commercially worldwide: compressed natural gas (CNG) and liquefied natural gas (LNG). CNG is natural gas that has been compressed under high pressures, typically between 2,000 and 3,600 psi (pounds per square inch). LNG is natural gas that has been condensed to a liquid. The engines in both types of vehicles operate the same; the major difference is the fuel storage system. Figure 2 and Table 1 show the number of NGVs worldwide.

Table 1. Estimated Number of Natural Gas Vehicles in the United States, 1995-1999

	1995	1996	1997	1998	1999
CNG	50,218	60,144	68,571	78,782	89,633
LNG	603	663	813	1,172	1,422
Total	50,821	60,807	69,384	79,954	91,055

Sources: 1992-1995: Science Applications International Corporation, "Alternative Transportation Fuels and Vehicles Data Development," unpublished report prepared for the Energy Information Administration (McLean, VA, July 1996). 1996-2000: Energy Information Administration, Office of Coal, Nuclear, Electric, and Alternate Fuels.

Conclusions

Programs including the AIJ Pilot Phase provide market-based mechanisms to provide opportunities for the creation of GHG emission reductions in the transportation sector worldwide. The NETL study, "Reducing Greenhouse Gas Emissions from Natural Gas Vehicle Projects: A Primer," will provide critical information for increasing the number of GHG emission reduction projects using transportation technologies worldwide by addressing issues including:

- The quantification, monitoring and verification (M&V) of potential GHG emission reductions for NGV technologies;
- The advantages and disadvantages of tail-pipe versus full fuel cycle data for emission reduction estimates; and
- Recommendations for reducing the transaction costs of M&V for dispersed technologies, such as transportation.

Footnotes:

[1] *Voluntary Reporting of Greenhouse Gases Form Instructions*, Energy Information Administration, U.S. Department of Energy, 2000, www.eia.doe.gov/oiaf/1605/frntvrgg.html

[2] Alternative fuels are substantially non-petroleum and yield energy security and environmental benefits. DOE currently recognizes the following as alternative fuels: methanol and denatured ethanol as alcohol fuels (alcohol mixtures that contain no less than 70% of the alcohol fuel), natural gas (compressed or liquefied), liquefied petroleum gas, hydrogen, coal-derived liquid fuels, fuels derived from biological materials, and electricity (including solar energy).

[3] Wang, Michael Q., "Fuel-Cycle Greenhouse Gas Emission Impacts of Alternative Transportation Fuels and Advanced Vehicle Technologies," *Transportation Research Record 1664*, Paper No. 99-1327.